

## CLAIMS

What is claimed is:

1. A method of preparing a specimen for microanalysis, the method comprising:
  - (a) embedding the specimen within an electrically conductive matrix to yield an embedded specimen; and
  - (b) forming regions on the embedded specimen into shapes suitable for microanalysis by an atom probe.
2. The method of claim 1, wherein in step (a), the specimen is embedded within a polymer matrix.
3. The method of claim 1, wherein in step (a), the specimen is embedded within an intrinsically conductive polymer matrix.
4. The method of claim 1, wherein in step (a), the specimen is embedded within a polymer matrix and further comprising a step of treating the polymer matrix to increase its conductivity.
5. The method of claim 4, wherein the polymer matrix is treated with a metal-containing compound, wherein the treatment increases the conductivity of the polymer matrix.
6. The method of claim 4, wherein the polymer matrix is treated with a metal-containing compound selected from a group consisting of osmium-containing compounds and ruthenium-containing compounds.
7. The method of claim 4, wherein the polymer is treated with a metal-containing compound selected from a group consisting of osmium tetroxide and ruthenium tetroxide.

8. The method of claim 1, wherein in step (a), the specimen is embedded within a hydrogel.

9. The method of claim 1, wherein in step (a), the specimen is embedded within the electrically conductive matrix by mixing the specimen with a corresponding monomeric compound and then polymerizing the monomeric compound to yield the electrically conductive matrix.

10. The method of claim 1, wherein in step (a), the specimen is embedded within the electrically conductive matrix by mixing the specimen with a corresponding pre-polymer compound and then polymerizing the pre-polymer compound to yield the electrically conductive matrix.

11. The method of claim 1, wherein in step (a), the specimen is embedded within the electrically conductive matrix by mixing the specimen with a corresponding water-soluble monomeric compound and then polymerizing the monomeric compound in aqueous solution to yield the electrically conductive matrix.

12. The method of claim 1, wherein in step (a), the specimen is embedded within a matrix comprising a polymer selected from a group consisting of polythiophenes, polyanilines, polypyrroles, and combinations thereof.

13. The method of claim 1, wherein in step (a), the embedded specimen is disposed on a substrate prior to step (b).

14. The method of claim 1, wherein in step (a), the embedded specimen is disposed on a substrate after step (b).

15. The method of claim 1, wherein in step (b), the regions are formed using focused ion beam lithography.

16. The method of claim 1, wherein in step (b), the regions are formed by doping the embedded specimen with a masking agent and then exposing the embedded specimen to a broad ion beam under conditions and for a time sufficient to remove the masking agent from the embedded specimen, whereby regions protruding from embedded specimen and suitable for microanalysis by an atom probe are formed.

17. The method of claim 1, wherein in step (a), the embedded specimen is disposed on a substrate prior to step (b) to yield a specimen-coated substrate, and then, in step (b), forming regions on the specimen-coated substrate suitable for microanalysis by an atom probe.

18. The method of claim 17, wherein in step (b), the regions are formed using focused ion beam lithography.

19. The method of claim 1, wherein in step (b), the regions are formed by doping the specimen-coated substrate with a masking agent and then exposing the specimen-coated substrate to a broad ion beam under conditions and for a time sufficient to remove the masking agent from the embedded specimen, whereby regions protruding from embedded specimen and suitable for microanalysis by an atom probe are formed.

20. The method of claim 1, wherein in step (a), an organic or biological specimen is embedded within the matrix.

21. The method of claim 1, wherein a protein is embedded within the matrix.

22. The method of claim 1, further comprising the steps of forming regions on a substrate suitable for microanalysis by an atom probe, and immobilizing the embedded specimen on the formed regions of the substrate, whereby regions on the embedded specimen are formed into shapes suitable for microanalysis by an atom probe.

23. The method of claim 1, further comprising the steps of forming regions on a substrate suitable for microanalysis by an atom probe, and immobilizing the specimen on the formed regions of the substrate, and then coating the formed regions of the substrate with the electrically conductive matrix, whereby the specimen is embedded within the matrix.

24. The method of claim 1, further comprising stabilizing the specimen by forming internal cross-links within the specimen, by forming cross-links between the specimen and the matrix, by forming cross-links between the specimen and a substrate, or combinations thereof.

25. The method according to any one of the preceding claims, further comprising step (c): and then microanalyzing the shapes formed in step (b).

26. The method of claim 25, wherein in the shapes are microanalyzed by atom probe microscopy.

27. The method of claim 25, wherein in the shapes are microanalyzed by local electrode atom probe microscopy.

28. An atom probe specimen fabricated by a method according to any one of claims 1 to 24.

29. A composition of matter comprising an intrinsically conductive polymer whose conductivity has been altered by contact with a compound selected from a group consisting of osmium tetroxide, ruthenium tetroxide, and combinations thereof.